Docket No.: 503.38097CX1

REMARKS

Reconsideration and allowance of the above-identified application, as a currently amended, is respectfully requested.

The title of the invention was amended in accordance with the Examiner's suggestion.

By the above amendments, also, claims 1-3 are now pending of which claim 3 was newly presented. Claim 3 was added to more particularly define the structurally characterizing aspects set forth in base claim1 (e.g., see page 12, line 4 et seg; page 18, line 7 et seg, of the Specification).

Independent claim 1 is directed to a semiconductor device which, among the featured aspects thereof, includes a first electrode formed on a front plane of a semiconductor substrate, a second electrode provided on the rear plane of the semiconductor substrate, a first metallic member connected to the first electrode and a second metallic member connected to the second electrode. Also according to claim 1, the second electrode is connected to the second metallic member via a metallic layer containing precious metal, and the metallic layer is a composite metal layer comprised of a first precious metal layer provided at the front plane of the second electrode and a second precious metal layer adhered thereto by compression bonding provided at the front plane of the second metallic member. That is, a precious metal layer (e.g. practically, of vapor deposit film of Au or Ag) is formed on the second electrode and another precious metal layer (e.g. a Ag plated film) is formed on a surface of the second metallic member. Ag particles or Ag sheet is inserted between the second electrode and the second metallic member, and the second electrode and a second metallic member or then metallic bonded by, for example, thermal-compression bonding or ultrasonic thermal-compression bonding.

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A featured aspect of the semiconductor device defined in claim 1 is that the second electrode and the second metallic member are connected through the metallic layer containing the precious metal, i.e., the metallic layer connects the precious metal (or first precious metal layer) provided at the front plane of the second electrode with the precious metal (or second precious metal layer) provided at the front plane of the second metallic member. It can be said, therefore, that such connecting construction of the electrodes of the rear plane of the chip (or substrate), according to claim 1, is understood to mean a connection between two precious metals. Accordingly, by forming such a connection of two precious metals, both a high thermal conductivity for the connection at the rear plane of the chip and a high reliability are achievable.

With regard to the invention defined in independent claim 2, the bonding region basically relates to the area where the gold (Au) bump is geometrically in contact with, for example, the aluminum pad. According to claim 2, at least 80% of an area of a Au/Al bonding region is contacting a corresponding Au bump, and that the bonding region associated with a pad is made of a Au/Al alloy layer in the thickness direction. According to independent claim 2, the chip electrode is constructed with a film of Al electrode or Al metal alloy, the connecting surface of the metal member is constructed with a metal plating film of the precious metal, the chip electrode and the metal member are connected with the Au bump, and at least 80% of the Au/Al bonding region is made of Au, Al metal alloy in the thickness direction (see page 13, lines 9-15, of the Specification). It can be said, therefore, that the reliability in the contact affected during the heat cycle under temperature conditions below 150°C or at the high temperatures is improved considerably (see for example the discussion related to Fig. 30 of the drawings). It is submitted, the invention

according to claims 1 and 2 and, further, according to claim 3(dependent on claim 1) could not have been achievable as that alleged in the outstanding rejection. Therefore, insofar as presently applicable, the previously standing rejection under 35 U.S.C. 103(a) over the combination of Kasem, et al. (U.S. 6,249,041) in view of Nakamura, et al. (JP 1-266752) and Osawa, et al. (U.S. 6,077,727), is traversed and withdrawal of the same is respectfully requested.

Kasem, et al. disclosed a MOSFET package construction scheme which is considerably different from the presently claimed subject matter. It is submitted, there is neither description or suggestion made therein of a connection between two precious metals as is called for in the present claims. The package structure according to Kasem, et al. features a bonding scheme in which a lead frame and a chip are directly bonded via an adhesive layer (e.g. 19, 23). The adhesive layer may be, for example, a silver-filled epoxy or polyimide paste and, alternatively, may be a series of solder bumps or other electrically conductive, adhesive material (see column 4, lines 11-16). The present invention, however, sets forth a semiconductor device scheme in which the connection construction calls for the connection between two precious metals, which is distinctly different from that taught by Kasem, et al.

Nakamura, et al. disclosed a structure in which thermal compression bonding is effected between an aluminum (Al) electrode and a copper (Cu) lead through a gold (Au) bump. In other words, the type of connection structure taught by Nakamura, et al. involves a connection between a non-precious metal and a precious metal. For example, Nakamura's scheme features a connection between Al and Au or a connection between Au and Cu. Neither connection construction involves the connection between two (2) precious metals, which is in clear contradistinction with the invention according to claims 1-3. In accordance with

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claims 1 and 2, for example, the bonding of an Al electrode with a Au bump is effected by forming a Au/Al compound in which the surface of the lead to be bonded with the Au bump is plated with a precious metal, the Au bump and the lead are bonded to each by metal bonding with precious metals, and plural Au bumps are formed on a single electrode.

Osawa, et al. disclosed a manufacturing scheme for a lead frame. In this regard, Osawa taught using an ultrasonic bonding method between the Au side of a thin lead having a Au layer and Cu layer and electrode pads of the semiconductor chip. It is submitted, however, there is neither description or suggestion of a connection between the precious metals as presently called for in claims 1-3. With regard to Osawa, et al., the three metal layers 23a, 23b and 23c leads to an effective connection between the lower gold layer 23a and the copper layer 23b and a connection between the copper layer 23b and the upper gold layer 23c (see Figs 3 and 4 in Osawa, et al.). It is assumed that the referred to metallic member 14 in the rejection was intended to refer to the copper plate 11 in Figs 3-4 or copper plate 31a in Figs 5-7.

It is submitted, in view of at least the above noted differences between the present claimed subject matter with that taught by each of the applied references and noting that the deficiencies in each are not remedied even in view of their combined teachings, the invention could not have been rendered obvious from their combined teachings.

Therefore in view of the amendments presented hereinabove together with these accompanying remarks, reconsideration as well as favorable action on the presently pending claims, i.e., claims 1-3, and an early formal notification of allowability of the above-identified application is respectfully requested.

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To the extent necessary, Applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Antonelli, Terry, Stout & Kraus, LLP Deposit Account No. 01-2135 (Docket No. 503.38097CX1), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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